REMARKS

Claims 1-25, 36-46 and 64-70 are pending in this application. Non-elected claims 26-35 and 47-63 have been canceled. Claims 1, 2, 8, 21, 36, 37, 43 and 64 have been amended.

Claims 2, 8, 13-14, 21, 37, 43 and 64-70 stand rejected under 35 U.S.C. §112, second paragraph, as being "indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention." (Office Action at 2). Claims 2, 8, 21, 37, 43 and 64-70 have been amended to correct any perceived indefiniteness. Applicant notes that all pending claims are now in full compliance with 35 U.S.C. §112.

Claims 1-12, 15-23 and 36-42 stand rejected under 35 U.S.C. §102 as being anticipated by Ding et al. (U.S. Patent No. 5,814,563) ("Ding"). This rejection is respectfully traversed.

The claimed invention relates to a method of forming an opening in an insulative layer by etching the insulative layer with a composition of ammonia and at least one fluorocarbon. As such, amended independent claim 1 recites a "method of forming an opening in an insulative layer" by *inter alia* "etching said insulative layer with an etching composition consisting essentially of ammonia and at least one fluorocarbon." Amended independent claim 36 recites a "method for forming an opening in an insulative layer" by *inter alia* "etching an opening in said insulative layer . . . using a combination of ammonia and at least one fluorocarbon, wherein said fluorocarbon is selected from the group consisting of C_4F_8, C_4F_6, C_5F_8, CF_4, C_2F_6, C_3F_8."

Ding relates to a "method of etching a dielectric layer (20) on a substrate (25) with high etching selectivity, low etch rate microloading, and high etch rates." (Abstract). Ding teaches that the etching method employs a process gas comprising "(i)

fluorohydrocarbon gas for forming fluorine-containing etchant species . . . (ii) NH_3-generating gas . . . and (iii) carbon-oxygen gas." (Abstract).

Ding does not teach or suggest the limitations of the claimed invention. Ding does not teach or suggest etching of an insulative layer "with an etching composition consisting essentially of ammonia and at least one fluorocarbon," as amended independent claim 1 recites. Ding teaches an etching composition comprising a fluorohydrocarbon gas, an NH_3-generating gas *and* a carbon-oxygen gas. (Abstract). Accordingly, Ding necessarily teaches a carbon-oxygen gas as part of the processing gas. Thus, Ding fails to teach or suggest an etching composition "*consisting essentially of* ammonia and at least one fluorocarbon," as amended independent claim 1 recites.

Applicant points out that amended independent claim 1 does not recite the fully open term "comprising," but rather the narrower phrase "consisting essentially of" to better reflect the patentable aspects of the invention. Applicant further notes that courts have consistently held that "[B]y using the term 'consisting essentially of,' the drafter signals that the invention necessarily includes the listed ingredients and is open to unlisted ingredients that do not materially affect the basic and novel properties of the invention. A 'consisting essentially of' claim occupies a middle ground between closed claims that are written in a 'consisting of' format and fully open claims that are drafted in a 'comprising' format." Regents of Univ. of Calif. V. Eli Lilly & Co., 119 F.3d 1559, 1573, 43 U.S.P.Q.2d 1398, 1410 (Fed. Cir. 1997).

Ding also fails to teach or suggest "using a combination of ammonia and at least one fluorocarbon, wherein said fluorocarbon is selected from the group consisting of C_4F_8, C_4F_6, C_5F_8, CF_4, C_2F_6, C_3F_8," as amended independent claim 36 recites. As noted above, Ding specifically teaches the use of a "fluoro*hydro*carbon gas," which is a fluorocarbon containing hydrogen. Thus, Ding does not teach or suggest the use of a fluorocarbon which does not contain hydrogen and which is "selected from the group consisting of C_4F_8, C_4F_6, C_5F_8, CF_4, C_2F_6, C_3F_8," as amended independent claim 36 recites. Accordingly, the

limitations of claims 1-12, 15-23 and 36-42 are not described in Ding, and withdrawal of this rejection is respectfully requested.

Claims 1-25, 36-46 and 64-70 stand rejected under 35 U.S.C. §103 as being unpatentable over Tan et al. (U.S. Patent No. 6,140,168) ("Tan") in view of Ding et al. (U.S. Patent No. 5,814,563) ("Ding"). This rejection is respectfully traversed.

As noted above, amended independent claim 1 recites a "method of forming an opening in an insulative layer" by *inter alia* "etching said insulative layer with an etching composition consisting essentially of ammonia and at least one fluorocarbon." As also noted above, amended independent claim 36 recites a "method for forming an opening in an insulative layer" by *inter alia* "etching an opening in said insulative layer . . . using a combination of ammonia and at least one fluorocarbon, wherein said fluorocarbon is selected from the group consisting of C_4F_8, C_4F_6, C_5F_8, CF_4, C_2F_6, C_3F_8." Amended independent claim 64 recites a "method of forming a conductive plug inside a contact opening in an insulative layer" by *inter alia* "contacting said insulative layer with a plasma etchant mixture consisting essentially of ammonia and at least one fluorocarbon at a temperature within the range of about -50 to about 80 degrees Celsius so as to form a self-aligned contact opening in said insulative layer."

Tan relates to a "method of fabricating a self-aligned contact window" by "forming an undoped dielectric layer (114) on a substrate having a (sic) least gate structure." (Abstract; Figure 1B). Tan teaches that "dopants are implanted into a pre-determined region of the undoped dielectric layer and the dielectric layer with the dopants is then removed" to form, therefore, a self-aligned contact. (Abstract).

The subject matter of claims 1-25, 36-46 and 64-70 would not have been obvious over Tan in view of Ding. Indeed, the Office Action fails to establish a *prima facie* case of obviousness. Courts have generally recognized that a showing of a *prima facie* case of obviousness necessitates three requirements: (i) some suggestion or motivation, either in the references themselves or in the knowledge of a person of ordinary skill in the art, to

modify the reference or combine the reference teachings; (ii) a reasonable expectation of success; and (iii) the prior art references must teach or suggest all claim limitations. See e.g., In re Dembiczak, 175 F.3d 994, 50 U.S.P.Q.2d 1614 (Fed. Cir. 1999); In re Rouffet, 149 F.3d 1350, 1355, 47 U.S.P.Q.2d 1453, 1456 (Fed. Cir. 1998); Pro-Mold & Tool Co. v. Great Lakes Plastics, Inc., 75 F.3d 1568, 1573, 37 U.S.P.Q.2d 1626, 1630 (Fed. Cir. 1996).

In the present case, neither Tan nor Ding, whether considered alone or in combination, teach or suggest all limitations of amended independent claims 1, 36 and 64. Neither Tan nor Ding teach or suggest "etching said insulative layer with an etching composition consisting essentially of ammonia and at least one fluorocarbon" (claim 1) or "using a combination of ammonia and at least one fluorocarbon, wherein said fluorocarbon is selected from the group consisting of C_4F_8, C_4F_6, C_5F_8, CF_4, C_2F_6, C_3F_8" (claim 36). Tan and Ding also fail to teach or suggest a "method of forming a conductive plug inside a contact opening in an insulative layer" by *inter alia* "contacting said insulative layer with a plasma etchant mixture consisting essentially of ammonia and at least one fluorocarbon at a temperature within the range of about -50 to about 80 degrees Celsius so as to form a self-aligned contact opening in said insulative layer," as amended independent claim 64 recites.

As noted above, Ding teaches an etching composition comprising a fluorohydrocarbon gas, an NH_3-generating gas ***and*** a carbon-oxygen gas. (Abstract). Thus, Ding fails to teach or suggest an etching composition "*consisting essentially of* ammonia and at least one fluorocarbon," as amended independent claims 1 and 64 recite. As also noted above, Ding specifically teaches the use of a "fluorohydrocarbon gas," which is a fluorocarbon containing hydrogen. Thus, Ding does not teach or suggest the use of a fluorocarbon which does not contain hydrogen and which is "selected from the group consisting of C_4F_8, C_4F_6, C_5F_8, CF_4, C_2F_6, C_3F_8," as amended independent claim 36 recites.

Tan also fails to teach or suggest all limitations of amended independent claims 1, 36 and 64. Tan only mentions that a "suitable mixture of etching gases may consist of methyl trifluoride (CHF_3), carbon tetrafluoride (CF_4) and argon (Ar)." (Col. 3, lines 45-

47). Thus, Tan is silent about an etching composition "*consisting essentially of* ammonia and at least one fluorocarbon," as amended independent claims 1 and 64 recite, or about "a combination of ammonia and at least one fluorocarbon, wherein said fluorocarbon is selected from the group consisting of C_4F_8, C_4F_6, C_5F_8, CF_4, C_2F_6, C_3F_8," as amended independent claim 36 recites. For at least the above-noted reasons, the subject matter of claims 1-25, 36-46 and 64-70 would not have been obvious over Tan in view of Ding, and withdrawal of the rejection of these claims is respectfully requested.

Claims 1-25 stand rejected under 35 U.S.C. §103 as being unpatentable over Blalock et al. (U.S. Patent No. 5,286,344) ("Blalock") in view of Ding et al. (U.S. Patent No. 5,814,563) ("Ding"). This rejection is respectfully traversed.

Blalock relates to a method for "selectively etching a layer of silicon dioxide on an underlying stop layer of silicon nitride." (Title; Abstract). Blalock teaches that exposed areas of the silicon dioxide layer "are etched down to the silicon nitride stop layer, at a high SiO_2 etch rate and at a high level of selectivity of the SiO_2 etch rate with respect to the Si_3N_4 etch rate, with a fluorinated chemical etchant system." (Abstract). Blalock emphasizes that the fluorinated chemical etchant "includes an etchant material and an additive material." (Col. 4, lines 24-25; Abstract). Blalock also teaches that the "additive material comprises a fluorocarbon material in which the number of hydrogen atoms is equal to or greater than the number of fluorine atoms." (Col. 4, lines 25-28; Abstract).

The subject matter of claims 1-25 would not have been obvious over Blalock in view of Ding. The Office Action fails again to establish a *prima facie* case of obviousness. Neither Blalock nor Ding, whether considered alone or in combination, teach or suggest all limitations of amended independent claim 1. Neither Blalock nor Ding teach or suggest "etching said insulative layer with an etching composition consisting essentially of ammonia and at least one fluorocarbon," as amended independent claim 1 recites. Blalock fails to teach or suggest ammonia as part of an etching composition, much less "an etching composition consisting essentially of ammonia and at least one fluorocarbon," as amended independent claim 1 recites. Similarly, Ding teaches an etching composition comprising a

fluorohydrocarbon gas, an NH_3-generating gas *and* a carbon-oxygen gas. (Abstract). Thus, Ding fails to teach or suggest an etching composition "*consisting essentially of* ammonia and at least one fluorocarbon," as amended independent claim 1 recites. Accordingly, the subject matter of claims 1-25 would not have been obvious over Blalock in view of Ding, and withdrawal of the rejection of this claim is respectfully requested.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "**Version with markings to show changes made.**"

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

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Respectfully submitted,

By _____

Thomas J. D'Amico
Registration No.: 28,371
Gabriela I. Coman
Registration No.: 50,515
DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP
2101 L Street NW
Washington, DC 20037-1526
(202) 785-9700
Attorneys for Applicant

Version With Markings to Show Changes Made

1. (amended) A method of forming an opening in an insulative layer formed over a substrate in a semiconductor device, comprising etching said insulative layer with an etching composition consisting essentially of ammonia and at least one fluorocarbon so as to form said opening.

2. (amended) The method of claim 1, wherein said [method is performed to produce] opening is a self-aligned contact opening.

8. (amended) The method of claim 1, wherein said [contacting] etching is performed through a patterned photoresist mask.

21. (amended) The method of claim [18] 20, wherein said fluorocarbon is flowed into a reaction chamber at a flow rate of about 18 sccm.

36. (amended) A process for forming an opening in an insulative layer formed over a substrate in a semiconductor device, comprising:

forming a pair of adjacent gate stacks in said insulative layer;

forming side wall spacers on side walls of said adjacent gate stacks;

forming a patterned photoresist mask layer over said insulative layer; and

etching an opening in said insulative layer through an aperture in said patterned resist layer, wherein said opening is etched through to said substrate using a combination of ammonia and at least one fluorocarbon, wherein said fluorocarbon is selected from the group consisting of C_4F_8, C_4F_6, C_5F_8, CF_4, C_2F_6, C_3F_8.

37. (amended) The method of claim 36, wherein said [etching is performed to produce] opening is a self-aligned contact opening in said insulative layer.

43. (amended) The process of claim 42, wherein said contact opening is formed between said side wall spacers on [a] said pair of adjacent gate stacks [formed over said substrate].

64. (amended) A method of forming a conductive plug inside a contact opening in an insulative layer between adjacent gate stacks formed over a substrate in a semiconductor device, comprising:

contacting said insulative layer with a plasma etchant mixture [containing] consisting essentially of ammonia and at least one fluorocarbon at a temperature within the range of about -50 to about 80 degrees Celsius so as to form a self-aligned contact opening in said insulative layer between said gate stacks without an etch stop, wherein said contacting further forms a protective layer over opposed side wall spacers which have been formed over said gate stacks;

depositing a conductive plug inside said opening such that said conductive plug is separated from said side wall spacers by said protective layer.